In the Specification

Please amend the specification as follows:

Please replace the table on page 9, lines 7-11 with the following:

Table I

Adsorbate/Adsorbent/Plasticizer	Response
Methylene Blue/*DARCO G-60 carbon/1,4-butanediol	arene>alkene≥alkane
Disperse Red 19/*MAXSORB carbon/propylene carbonate	cyclic alkene>arenes≈alkane

* DARCO G-60 is activated carbon from American Norit Co., Inc. MAXSORB is activated carbon from Kansai Coke and Chemical.

Please replace the paragraph on page 12, lines 26-30, continuing on page 13, lines 1-19 with the following:

B1

A working embodiment of an integral, multilayer analytical element needs to incorporate several functions: sample capture, competitive desorption, concentration of the released radiant energy-detectable materials and, if the adsorbent is colored or significantly opaque, provision of a background against which the radiant energy-detectable materials can be detected. In certain embodiments, it is possible to combine certain of these functions into single layers. For detection of vapor analytes, it is preferred to construct the element as a three layer structure atop a transparent base, readable by reflectance. Referring to Figs. 1a-1d and to Fig. 2, four components can be present in analytical element (10), in order of distance from the base: the clear plastic base (12) itself, the concentrating layer (14) such as a dye mordanting layer, a reflecting layer (16), e.g., a white

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pigment, that also is sufficiently opaque to appear white under a dark adsorbent, and the adsorbent/indicator layer (18), which for vapor detection serves also as the sample capture layer. As illustrated in Fig. 1a, analytes in the vapor phase (v) diffuse into adsorbent/indicator layer (18), where, as shown in Fig. 1b, the analytes to be detected competitively displace the displaceable dye or dye precursor adsorbed onto the adsorbent. Figs. 1c and 1d show displaced dye molecules diffusing through reflecting layer (16) and collecting in concentrating layer (14), where they are detectable through clear plastic base (12).

B2

Please replace the paragraph on page 15, lines 18-30, continuing on page 16, lines 1-3 with the following:

For the opposite polarity situation, in which the choice of a polar adsorbent like silica or alumina and a relatively nonpolar dye leads to the choice of a hydrophobic, less polar solvent, there is a wide range of possible commercially available solvents that could be paired with standard thermoplastic polymers. Examples of suitable solvents include dialkyl diesters such as those sold as the DBE series (DuPont), diesters of aryl compounds including those commonly used as plasticizers for, e.g., polyvinyl chloride, polyvinyl acetate, cellulose nitrate, and the like, such as diethyl phthalate, long chain esters such as isopropyl palmitate, phosphate esters like tributyl phosphate, liquid chloroparaffins, sulfonamides like N-ethyl-o,p-toluenesulfonamide, amides such as diethyl lauramide, ethoxylated or propoxylated phenols such as IGEPAL OD-410 (Rhodia), and many others. A specific example might be the combination of polystyrene with dimethyl sebacate.

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Please replace the paragraph on page 16, lines 12-20 with the following:

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It may also be desirable to crosslink one or more layers to control swelling during overcoating. The choice of crosslinker will of course be dependent on the binder and drying conditions chosen. Alternatively, polymers that become insoluble on drying, for instance polyvinyl acetate lattices, or ones that become insoluble on heating such as ammonium salts of base-soluble but neutral water-insoluble polymers like CARBOSET 525 (BFGoodrich) or SCRIPSET 520 (Solutia), can provide swelling control either as primary binders or as additives.

Please replace the paragraph on page 18, lines 23-30, continuing on page 19, lines 1-13 with the following:

35

For anionic dyes, such as those commonly used in photographic applications, a wide range of cationic polymers, both commercial and custom-made, have been proposed. Commercial materials mentioned in prior art include the MIRAPOL line of cationic polymers (Rhodia), the CELQUAT cationic polymers (National Starch), cationic lattices such as HX42-1 (Interpolymer Corp.), hydroxypropyl trimethyl ammonium chloride hydroxyethylcellulose (POLYMER JR, Amerchol), and many others. These materials may be diluted in film forming neutral polymers such as polyvinylpyrrolidone, polyvinyl alcohol, cellulose ethers, polyvinyl butyral, polyacrylamide, or any other polymers that are compatible with the mordant and plasticizer/solvent and permeable to dye. Cationic dyes may be mordanted with anionic polymers such

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as carboxymethyl cellulose, polystyrenesulfonic acid salts, polyacrylic acid salts, naturally occurring anionic polymers such as alginic acid and carrageenan, copolymers of maleic acid such as those in the GANTREZ line (ISP), and many others. These may be diluted with compatible nonionic polymers such as those mentioned earlier. The polymer counterions may be varied to adjust compatibilities, regulate crosslinking, and achieve differing degrees of dye affinity.

6
35

Please replace the paragraph on page 16, lines 14-27 with the following:

For most purposes, it is desirable that this layer be transparent and uncolored. This is achieved by selecting components for compatibility in both the wet and dry states. This includes small molecules such as the plasticizer/solvent(s), preservatives, and surfactants. The last can be of value in insuring optimal coating quality, thereby maximizing transparency. In general, it is desirable to avoid surfactants with charge opposite to the mordanting polymer. Thus, for cationic mordants, a cationic wetting or leveling agent may be used, for example FLUORAD FC-135 (3M) or AEROSOL C-61 (Cytec). Anionic mordants can benefit from anionic wetting agents such as AEROSOL OT (Cytec) or RHODACAL DSB (Rhodia). Of course, either type of mordant could be compatible with many of the typical nonionic and amphoteric surfactants.

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Please replace the paragraph on page 19, lines 28-30, continuing on page 20, lines 1-18 with the following:

It is generally necessary for the mordant layer to be largely insoluble in the solvent being used to coat the next layer atop it. This may be achieved either by appropriate selection of component polymers, by design of the overcoat fluid, or by crosslinking the mordanting layer. For example, a hydrophilic mordant layer such as one composed of sodium carboxymethylcellulose would tolerate being overcoated with a reflecting layer using an organic solvent such as isopropanol or 2-butanone as its solvent. If it is desired to coat the overcoat from water, the mordant layer can have its solubility and degree of swell reduced to a usable level by adding water-insoluble binders such as polyvinylbutyral (added as e.g. an alcoholic solution), self-crosslinking binders like GOHSEFIMER Z-200 (a modified polyvinyl alcohol available from Performance Chemicals, Inc.) or X-LINK 25-2813 (a self-crosslinking vinyl acrylic latex from National Starch), or standard crosslinkers for functionalities present in one or more of the polymers in the mordant layer, for example, a titanate ester such as TYZOR LE (DuPont), if carboxylic acid units are present, or materials like 1,4-butanediol diglycidyl ether, POLYCUP 172 (Hercules), or glyoxal if hydroxyl groups are present.

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Please replace the paragraph on page 22, lines 4-10 with the following:

~~These core-shell pigments display reduced dye~~ photodegradation and easier dispersability which are both desirable. Examples of such modified titanium dioxides can be found in most titanium dioxide pigment manufacturer's lines, as exemplified by the pigments of the TI-PURE R-900 line (DuPont), Kemira's RDD and 650, Kronos 2310, 2102 and 2160, and similar pigments.

B8

Please replace the paragraph on page 22, lines 11-24 with the following:

The amount of pigment in the layer can vary over a wide range, depending on the particular pigment, how well dispersed it is, what other materials are in the pigment layer, and how thick this layer is coated. For titanium dioxide, coverages can range from 5 g/m^2 to 40 g/m^2, preferably in the range of 10 to 25 g/m^2. Layer thickness can be in the range of from 3 to 30 μm, preferably from 5 to about 20 μm. Pigment volume concentration can range from 25 percent to 75 percent, limited by the rheology of the coating fluid, the mechanical integrity of the dry layer, and the resistance to dye passage through this layer caused by the solid pigment particles. The required amount of titanium dioxide can be reduced be incorporation of low refractive index particles such as polytetraflouroethylene latices or ROPAQUE (Rohm & Hass) air encapsulates as is well known in the paint industry.

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Please replace the paragraph on page 23, lines 17-30, continuing on page 24, lines 1-5 with the following:

Titanium dioxide is generally dispersed in aqueous media with the aid of low molecular weight, anionic polymers such as polyacrylates like COLLOID 111 (Rhodia), polymethacrylates such as DAXAD 30 (Hampshire Chemical), naphthalenesulfonate-formaldehyde condensates such as TAMOL (Rohm & Hass), or blends with surfactants such as SURFYNOL CT-131 (Air Products). Small molecules like pyrophosphate salts and anionic surfactants such as GEROPON SS-O-75 (Rhodia) may also be suitable. It is desirable that the charge on the dispersant be the same as that of the dye or dye precursor, so as to avoid mordanting of the dye in the reflecting layer. For cationic dyes, cationic dispersants such as AEROSOL C-61 (Cytec), WITFLOW 953 (Witco), and cationic polymers like NALCO TX 7991 (Nalco Chemical) may be useful. Alternatively, nonionic dispersants such as the SOPROPHOR series (Rhodia), GLUCOPON 425N (Henkel), or GAFAC P-904 (ISP) may be tried, but they are generally somewhat less effective. Mixtures of charged and uncharged dispersants are also useful. Similar more hydrophobic dispersants of all three charge types are available for use in organic solvent-based coating fluids.

B10

Please replace the paragraph on page 24, lines 6-10 with the following:

It may also be of value to use a pigment wetting or grind aid as part of the dispersion process. Representative materials include SURFYNOL 104, CT-121, and CT-136 (Air Products), WITCO

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B11

960, WITFLOW 963 (Witco), and DISPERBYK 183 (Byk). SURFYNOL CT-136 and DISPERBYK 183 can also serve as dispersants.

Please replace the paragraph on page 24, lines 16-27 with the following:

B12

Other additives commonly used in the coatings, such as wetting agents, defoamers, and biocides can be incorporated into the coating. There are a wide selection of suitable materials commercially available. The primary requirement these materials must meet for use in a dye desorption analytical element is that they must either not be able to migrate to the detection layer, or should not be able to displace dye from the adsorbent. Some materials that have proven useful in systems based on activated carbon adsorbent include sodium benzoate and methanol as biocides, SURFYNOL 104PA and SURFYNOL 61 as wetting agents, and SURFYNOL DF-210 defoamer.

Please replace the paragraph on page 25, lines 1-15 with the following:

B13

Detecting Layer

Over the reflecting layer is coated the layer containing the dye desorption detection system. Exemplary adsorbents useful in the detection system include activated carbon, silica, alumina, ion exchange resins and molecular sieves. Also useful are polymers or polymer latices capable of binding dyes ion exchange resins like AMBERLITE IR 120 (Rohm & Hass) and molecular sieves such as 4A° sieves (W. R. Grace). Also useful are polymers or polymer latices capable of binding dyes. For example, polymers

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B13

containing vinylprrolidone units are known to have an affinity for many classes of dyes, but as the interactions are weak, other molecules with comparable polarity and hydrogen-bonding characteristics could serve to displace these dyes and hence be detected. Particulate neutral polymeric adsorbents such as AMBERLITE XAD series (Rohm & Hass) are also applicable.

Please replace the paragraph on page 26, lines 3-17 with the following:

B14

Finding appropriate binders is a process that is sensitive to the choice of plasticizer/solvent as well as adsorbent and dye or dye precursor. For example, although in an analytical element for the detection of aromatic hydrocarbons by desorption of Methylene Blue from activated carbon using a diol plasticizer/solvent, polyvinyl alcohol is a satisfactory binder for a titanium dioxide reflective layer, but not for the activated carbon detecting layer. However, cellulosic polymers such as KLUCEL (Hercules) or METHOCEL (Dow) do permit dye to leave the carbon surface and migrate to the mordant layer. Similarly, wetting agents and other coating aids must be selected carefully to avoid interference with the detection system. Combinations of polymers may be particularly useful in this layer to maximize permeability to both analytes and dyes while providing the mechanical robustness necessary for an unprotected top layer.

Please replace the paragraph on page 26, lines 25-30, continuing on page 27, lines 1-13 with the following:

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Example 1

A vapor detection system based on dye desorption was prepared as follows: a mordant layer comprising the commercially available polymer GANTREZ AN-169 (ISP) at 1300 mg/m², 2-methyl-1,3-propanediol at 7786 mg/m², and RHODACAL DSB (Rhodia) at 13.0 mg/m² was coated from water using a wound-wire rod onto a transparent, subbed polyester support from water and dried 5 minutes at 115 °C. Over this layer was coated a reflecting layer containing the following materials:

B5

MATERIAL	COVERAGE (mg/m²)
TI-PURE R-900 titanium dioxide (DuPont)	26,087
dispersant DAXAD 30 (Hampshire Chemical)	137
wetting agent SURFYNOL 104PA (Air Products)	1565
defoamer SURFYNOL DF-210 (Air Products)	1159
2-methyl-1,3-propanediol (Arco Chemical)	579
AIRVOL 107 (Air Products)	2673
ammonium titanium lactate (50% solution) (Aldrich)	406

Please replace the paragraph on page 27, lines 14-28 with the following:

B6

These materials were coated from an aqueous dispersion that was prepared using a rotor-stator homogenizer. The coating fluid was applied using a wound-wire rod. The resultant two-layer structure was oven-dried for 20 minutes at 115 °C. The magenta dye Pyronin Y (Aldrich) was adsorbed from water onto DARCO G-60 activated carbon (NORIT) at 60 mg/g carbon. The dye loaded carbon was then used to prepare a sensing layer composed as follows:

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B/6

MATERIAL	COVERAGE (mg/m^2)
Pyronin Y on carbon	4930
2-methyl-1,3-propanediol	9076
METHOCEL K35LV hydroxypropylmethylcellulose (Dow)	148
polyethylene oxide 600K (Aldrich)	58.3
WITCOBOND W-213 polyurethane latex (Ashland Chemical)	430

Please replace the paragraph on page 27, lines 30-32, continuing on page 28, lines 1-2 with the following:

B/7

This layer was coated from water with a wire-wound rod, and air-dried. The completed detector was tested by attaching it to a clear glass plate that was then glued with POLECTRON 430 adhesive latex (ISP) onto a jar containing a small beaker of test solvent that served as a source of vapors to be detected.

Please replace the paragraph on page 28, lines 13-33, continuing on page 29, lines 1-5 with the following:

B/8

Example 2

Different mordant layers were prepared from GANTREZ AN-169 in a manner analogous to Example 1, except that the amount and type of base was varied. Bases used included sodium and potassium hydroxides and lithium carbonate, as well as amines including ethanolamine, diethanolamine, and triethanolamine (all from Aldrich). These mordants were used to prepare multi-layer structures comparable to Example 1. All gave significant color on exposure to toluene vapors. Maximum optical densities were as follows:

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BASE	DYE	%NEUTRALIZATION	MAGENTA Dmax (Dmin)
ethanolamine	Pyronin Y	100	1.43 (0.20)
diethanolamine	"	100	1.56 (0.20)
triethanolamine	"	100	1.45 (0.19)
triethanolamine*	"	100	1.15 (0.19)
triethanolamine	"	33	1.71 (0.19)
NaOH	"	33	1.71 (0.20)
Li2CO3	"	33	1.76 (0.19)
no base	"	0	1.72 (0.22)
NaOH	Methylene Blue (Aldrich)	33	2.06 (0.19)
KOH	"	33	1.39 (0.19)
NaOH	Thionin perchlorate (Aldrich)	33	1.45 (0.22)
no base	"	0	2.12 (0.21)

* GANTREZ ES-225 in place of GANTREZ AN-169

Please replace the paragraph on page 29, lines 24-34 with the following:

Example 4

An alternative mordant layer was formulated as follows:

3/9

MATERIAL	COVERAGE (mg/m^2)
VERSA TL-502 polystyrenesulfonate (Alco Chemical)	460.7
GOHESFIMER Z-200 (Performance Chemicals)	26.50
AIRVOL 125 (Air Products)	1677.0
polyvinylpyrrolidone K-15 (ISP)	462.4
1,2-propanediol (Aldrich)	21269.0
NaOH	3.40
RHODACAL DSB surfactant	105.1

Please replace the paragraph on page 30, lines 1-9 with the following:

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Example 5

An alternative carbon layer was formulated as follows:

MATERIAL	COVERAGE (mg/m2)
Pyronin Y on carbon	5151.5
2-methyl-1,3-propanediol	9485.0
METHOCEL K35LV hydroxypropylmethylcellulose	154.3
polyethylene oxide 600K	60.9
DUR-O-SET SB-321 polyvinyl acetate latex (National Starch)	258.6

B20

Please replace the paragraph on page ~~30~~, lines ~~11~~-~~28~~ with the following:

Example 6

B21

The maximum viewing surface dye densities resulting from exposure to various vapors of the coated structure of Example 1 were determined by reflection densitometry using an X-RITE 310 densitometer (X-Rite Systems, Grandville, MI) in Status A mode. Two coatings were compared, that of Example 1 and another identical except for the replacement of Pyronin Y by the blue-violet dye Thionin perchlorate.

	Pyronin Y 60 mg/g on Darco G-60	Thionin ClO4 120 mg/g on Darco G-60
toluene	0.71/0.30/1.72/0.99	1.69/1.09/2.11/0.63
CH2Cl2	0.56/0.41/1.03/0.62	1.59/1.15/1.76/0.72
amyl acetate	0.49/0.27/1.01/0.52	0.57/0.47/0.53/0.37
i-octane	0.18/0.18/0.23/0.21	0.25/0.24/0.25/0.24

Dye densities are in units of reflectance optical density in the order visual/cyan/magenta/yellow. Unexposed material has D_{min} = 0.18/0.19/0.22/0.21.

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Please replace the paragraph on page 31, lines 10-18 with the following:

B22

Example 8

The effect of toluene vapor on three devices identical except for containing three different dyes was examined. The dye loadings were chosen to give comparable D_{min} values:

Dye	Dmin	Dmax
Pyronin Y	0.10/0.09/0.10/0.11	1.19/0.58/2.63/1.97
Methylene Blue	0.11/0.11/0.11/0.12	1.82/1.32/2.06/1.27
Thionin perchlorate	0.15/0.12/0.12/0.12	2.49/1.98/2.64/1.29

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